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***Abstract* – The purpose of this work in progress is to present a method of project development and team creation that is student driven. There are a variety of ways in which to develop course projects, usually being instructor driven in the freshman year. However, if our objective is to help students become more independent, entrepreneurial focused thinkers, the earlier we let them have control the better. The same idea should apply to the creation of teams within courses. We delivered two different team formation approaches across seven sections of a common first year engineering course. One approach involved an organized self-selection process. The other approach was a more traditional approach of instructor selection based on survey results. Anecdotal evidence is very positive for the new approach, however, data is not currently available comparing the methods for any statistical claims to be made. It should also be noted that four sections had common instructors using the two different methods, allowing for the removal of instructor bias. Also one section involved a cross disciplinary approach with a section of first year business students.**

Index Terms – Teamwork, Design Teams, Team Formation.

Teams – Why?

Regardless of the work environment, working in teams is a fact of life. Whether students work in an engineering firm or other type of business, they will need to work in cross-functional teams. The sooner students can begin to develop good team skills, the better. "Why do some students flounder on their initial job assignments after graduation, while others move quickly up the career ladder? One common criticism voiced by employers is that new hires do not seem to function well in a team-based environment." [1] Of course the ability to function on multidisciplinary teams continues to be a student outcome for ABET accreditation [2].

High performing students are often challenged in teamwork situations. Students who have performed at a high level in high school as measured by GPA and scored well on standardized tests are used to achieving success as a result of their own efforts. The thought of having their own success be dependent on the efforts of someone else can provoke anxiety. Often times these students approach teamwork in college by doing it all on their own. This allows them to guarantee that the output of the team project will meet their standards with the fewest complications. This approach works because high performing students are often teamed with students who are only too happy to let someone else manage and control the project. Thus, while an acceptable solution for the students, this is a suboptimal team experience.

These situations are hard enough when students are teamed together within the same discipline (all biomedical or mechanical), and only slightly more complicated when teamed across disciplines within engineering (mechanical, industrial and electrical). This reaches a whole new level if we go truly interdisciplinary and team engineering students with students in disciplines outside of engineering (business and engineering).

From an innovation perspective "Continuous innovation requires a process for understanding and addressing customer needs (jobs to be done)—and we integrate three perspectives in doing so: design thinking, entrepreneurial leadership, and collaborative teamwork." [3] Furthermore, "…a better understanding of teams in early-stage ventures can help students work more effectively within their project teams, likewise, their experiences working in their project teams can inform their knowledge about teams in early-stage ventures. In both settings, people with little history working together and from various disciplinary and experience backgrounds come together to create something that hadn't existed before. This diversity of perspective brings with it the opportunity for unique combinations of knowledge that could not have occurred separately. It also brings with it the risk of an inability to communicate and understand one another, which can result in conflict and frustration." [3]

Teams – How?

If you have been in academics long enough you have probably experimented with various different ways for creating teams. At one end of the spectrum is classic

random assignment, an approach not guaranteed to create teams with optimal efficiency. Every now and then we may get a great one, but overall we may end up with many dysfunctional teams. A strength of this approach for the faculty member is it takes almost no effort, and allows for an "everyone is in the same boat" rationalization; in essence, an efficient way to spread the pain and not worry about it.

At the other end of the spectrum is the use of programs like CATME that allow for the input of data on a variety of dimensions such as GPA, class schedules, open time blocks, etc. Then, teams are created that appear to be the best fit; best fit, that is, with respect to the quantitative dimensions input into the program.

In between, we have tried other methods. Average out the GPAs so all teams are equal, or put low GPA students in teams separate from the high GPA students; separate men and women on teams; consolidate majors, or integrate majors. The point is that there are many different ways of creating teams, and perhaps the reason why some of us use different methods is the search for an efficient team experience. Efficient for both the students and faculty. When student teams go bad, it makes faculty life miserable too.

It sounds cliché, but students are human. As much as we would like to find the optimal model for creating teams, we still have to deal with the uncertainties related to personalities and behaviors. These are very difficult to account for. So, let's try letting the students create the teams. Others have suggested letting students pick their own teams is sub-optimal, "… letting students pick their own groups often results in a barrier to team cohesiveness since they tend to pick their friends, and other group members that do not belong to this subgroup are likely to feel excluded." [4]

It is the "tell me who you want to work with" method. Friends get to work with each other and they think that is great. Except, then students find that the reason they are friends is because they "don't" have to work with each other. What about the left-overs, they end up in a team where none are friends. Suboptimal outcomes, again.

Turning over the keys to the car

The approach we present here allows students to drive the subject of a term project, as well as allowing students to be on a team with a self-selected common goal; as opposed to an instructor-selected goal. Let's be clear, the instructor is still setting the parameters of the project in terms of due dates, quality of output, etc., students get to select the focus that most interests them. The process discussed below includes students from two separate courses, one engineering and one business, and has a truly interdisciplinary focus. The process described is a modified version of the process using in the 3 Day Startup [5].

Identifying Painpoints: This process starts with a preparation assignment to generate initial ideas. Students, working individually, must identify three painpoints, or sources of frustration, disappointment, or dissatisfaction that people experience. There are initial background readings prepared by the instructors in technological, social and cultural trends to help students understand the context in which they live. Then, students engage in an environmental scanning activity reviewing newspapers, news websites, talking with relatives and friends, and other information sources searching for painpoints.

Selecting Painpoints: After having prepared themselves, each student brings two or three painpoints to a joint class with both engineering and business students in attendance. This class is held in a flexible classroom that allows for a variety of configurations that can be adjusted to the activity of the day. Random, temporary, *ad hoc* interdisciplinary teams of students are created, approximately four students per team, in which each student presents one or two of their painpoint ideas. Teams are given adequate time to present and discuss the painpoints they think are most interesting, selecting two per team to present to the entire class.

Presenting Painpoints: The next step in the process representatives from the *ad hoc* teams present to their ideas in 2 minutes or less to the entire class. With a combined class of approximately 40 students this process generates 14 to 16 ideas for further consideration. All finalist painpoint ideas are written on the board.

Identifying Project Ideas: With a final list of ideas identified, each student in class gets two votes in a "heads down, hands up" voting exercise. The top six to eight vote-getting ideas are selected for semester–long projects.

Team Formation: At this point, the person whose idea has been selected by the class for the term project is assigned to a specific location in the classroom. Students whose idea was chosen are then the *de facto* project champions. The remaining students are then allowed to select which project they would like to work on for the semester. This is done one by one as the professor randomly calls each remaining student. The primary focus for project selection is which topic they find most interesting.

This approach has been used in different situations with different types of projects. It had to be modified in the joint engineering – business student team project to meet a couple of objectives. First, the teams had to be interdisciplinary, so engineering students and business students were working together. Second, teams were limited to four to six students for team effectiveness.

Differences with past approaches

Initial observation indicated that the approach presented shows several benefits including fewer interpersonal problems, more project ideas from business students selected as well as project champions from both disciplines. At this point these observations are anecdotal, more

thorough data will be available at the time of the conference through the delivery of a survey.

Challenges

While it is believed that the method presented is superior in many ways a few drawbacks do exist including less direct control by the instructor and conflicts with team size. That is, if even numbers of students are needed then the last student to select will inevitable be forced on a team, which can be a problem in certain situations.

Future Directions

As a "Work in Progress" data has not been collected to assess the effectiveness of the method presented. Teams were created using the method presented here along with other team formation methods across several sections of a common first year engineering course. By the time of the conference these data will be available.

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